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# M4Or1A-03: [Invited] Low ac loss HTS-2212 wire, cables and coils for operating above 22K in much higher power density rotating machines

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Higher field, much lighter-weight and more efficient ac magnets that can operate at affordably cooled temperatures above 22 K require a new HTS conductor design. Stator coils for example operate in fast AC modes where HTS tapes cannot be used due to excessive induction-driven losses, requiring instead HTS as small cross-sectioned, fine-filament, axially twisted wires in transposed cable forms. An approach has been previously described that builds all required loss reducing features into small, nominally 0.16 mm diameter round Bi2212 wires, with non-merged, small-sized. to order 10 mm filaments, short twist pitch lengths in the 5 to 10 mm range, and increased inter-filament resistances. Recently, through process and material science developments, the Je levels attained in these wires now match those attained in the highest performance 2212 magnet wires that do not include loss reducing features. In parallel, wire fabrication was also successfully scaled to produce 3 km piece lengths. Building on these advances, fully transposed low loss cable design developments are under way. Recent wire-related advances and application of these low loss wires to develop advanced, fully transposed low loss 2212 cables, with attributes that are tailored to meet all the specific requirements of applications of for example high power density electric plane propulsion motors. A long length generic cabling line has been developed, cabling processes established, and prototypes made, including a baseline 16-strand Rutherford design and a cable-of-cables 48-strand design and also with even higher strand count cables under development. The processes and designs of these of the 16-strand cable has been optimized with respect to performance to where to strand Je levels are approaching the Je levels non cabled wires and that enable stator operation at above 22 K. Techniques for reinforcement have also been developed and validated. Their suitability to the fabrication of advanced coil designs is now also under development and in excess of 70 prototype test coils have been made to optimize coil designs and fabrication

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